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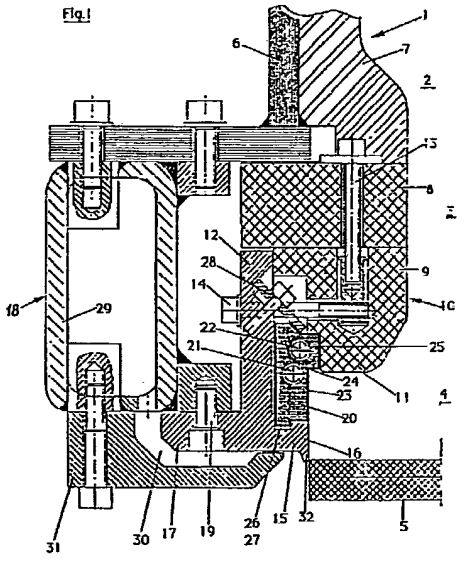
(54) Continuous or semi-continuous casting apparatus for casting metallic materials.

(57) A continuous or semi-continuous casting apparatus for casting metallic materials, particularly rectangular ingots of aluminium, comprises a mould which has an inlet for the filling of melted metal and a mould cavity with an outlet, water supply means being provided for cooling the metal. The mould cavity is provided with a permeable ring for the supply of oil and/or gas, such that a layer of oil and/or gas is formed between the metal and mould wall whereby the metal is prevented from coming into contact with the mould wall before it solidifies. The surface of the ring, with the exception of the side facing the mould cavity, is provided with a sealing agent which prevents the oil and/or gas from escaping through the surface. Further, the ring, in its peripheral direction, is provided with longitudinal bores or holes for supplying oil and/or gas to said ring via bores which extend from outside the mould cavity through the mould wall and further into the graphite ring.

Fig.1



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Description

CONTINUOUS OR SEMI-CONTINUOUS CASTING APPARATUS FOR CASTING METALLIC MATERIALS.

The present invention relates to continuous or semi-continuous casting apparatus for casting metallic materials, particularly rectangular ingots of aluminium, comprising a mould cavity which has an open inlet for molten metal and an outlet with water supply means being provided to cool the metal emerging through the outlet, the mould cavity, at a distance from its inlet, being provided with a permeable ring for a supply of oil and/or gas, to create a layer of oil and/or gas between the metal and the mould wall whereby the metal is prevented from coming into contact with the mould wall before it solidifies.

It is previously known to supply oil or gas to the mould cavity as mentioned above. Inter alia NO patent application No. 830858 reveals a casting apparatus for ingots where gas and oil is supplied to the mould cavity via a graphite ring which is disposed in the mould wall close to the mould outlet.

Oil and gas is supplied to the graphite ring through separate bores in the outer mould wall (sleeve). The oil and gas is distributed around the periphery of the ring by means of channels on the outer side of the ring which are connected to the bores in the sleeve.

To avoid oil and gas leakage between the ring and sleeve, it is necessary that the ring and sleeve are tightly sealed to one another. Thus the diameter of the graphite ring is machined so as to be greater than the diameter of the sleeve. When mounting takes place, the sleeve is heated and so expands outwards so that the ring can be placed in its correct position in relation to the sleeve. The sleeve will shrink on cooling, so achieving a tight seal between the ring and sleeve. However, this required a very fine machining of the ring as well as the sleeve, and the smallest surface defect or scratch will result in leakage.

With the above demands regarding tolerances and surface roughness, it is obvious that the graphite ring revealed in the previously mentioned NO patent application is expensive to manufacture and use.

The above type ring is not applicable for casting apparatus producing rectangular ingots, primarily because the metal parts of the mould are milled, and secondarily because the graphite "ring" has to have a rectangular configuration, i.e. the sides of the ring (frame) will be deflected inwardly so that it is impossible to use force fit between the ring and the sleeve.

It has been an object of the present invention to provide a casting apparatus with a permeable ring, for instance of graphite, which is not encumbered with the above disadvantages, i.e. which is simple and inexpensive to manufacture and which is particularly applicable to casting apparatus used to produce rectangular ingots or other types of continuous or semi-continuous cast products where the cross section deviates from the circular.

Such a ring according to the invention is characterized in that its surface, with the exception of the surface facing the mould cavity, is provided with a sealing agent which prevents the gas and/or oil from penetrating said surface, and in that the ring in its peripheral direction is provided with longitudinal bores and holes for supplying oil and/or gas to these longitudinal bores via bores through the mould wall and extending into the graphite ring from the outside.

The invention will now be described by way of example only and with reference to the drawings in which:

Figure 1 is a vertical cross section of the side wall of a casting mould for casting rectangular ingots in which the ring according to the invention is used,

Figure 2 shows another vertical cross section of the same,

Figure 3 shows the ring in a smaller scale, from above,

Figure 4 shows in cross section an example of a circular ring composed of ring elements,

Figure 5 shows the different ring elements of which the ring according to Fig. 4 is composed,

Figure 6 shows another example of a ring made of ring elements.

As mentioned above Figure 1 shows a vertical cross section of a casting mould for casting rectangular ingots. Since the ingots have rectangular shape, it will be understood that the casting mould according to the present example has four walls, each with an internal configuration as shown in Figure 1.

The hollow mould comprises a vertical inlet 2, an inwardly protruding middle 3, and a lower mould cavity 4 which has a length and width relationship corresponding to the cross sectional measurements of the ingot.

A support 5 is provided at the outlet of the mould cavity 4, the support 5 being moveable in the vertical direction by means of a piston/cylinder arrangement or the like (not shown). This support 5 seals off the opening of the mould at the beginning of the casting cycle.

The mould inlet wall consists of an outer reservoir frame 6 made of steel, on the inside of which is provided a plate 7 of refractory material. The reservoir frame is further connected to a base frame 18 which is also made of steel.

Below the refractory plate 7 additional pieces 8,9 of refractory material form the middle part of the mould, the so-called "hot-top" 10.

The hot-top forms a narrow passage through which the molten metal flows and also creates an overhang with a flat part 11 at the inlet of the mould cavity 4.

The refractory pieces 8,9 are secured to one another by means of a screw connection 13, which in turn is secured to an aluminium/steel sleeve 12 by means of another screw connection 14. At its lower end the sleeve 12 is provided with an inwardly protruding projection 15 the lower side wall of the

mould cavity being formed by the end 16 of projection 15. The sleeve 12 also has a leg 17 protruding outwardly, in opposite direction relative to the projection 15. The leg 17, and thereby the sleeve 12, is securely attached to the base frame 18 by means of a screw connection 19.

A permeable ring 20 is provided between the projection 15 and the hot-top 10, its inner side, 23 forming the upper side wall of the mould cavity 4. The ring 20, in the present example, is also provided with an inwardly extending step 25, the downwardly facing side 24 being somewhat withdrawn (at a higher level) relative to the horizontal part 11 of the hot-top 10 (approximately 1-2 mm).

During the casting process, gas is supplied to the ring 20 and a gas cavity is created in this area which provides an isolating layer between the ring 20 and the melt and which provides an even distribution of gas all around the hollow mould periphery.

The permeable ring 20 is further provided with two bores 21,22 in the longitudinal (peripheral) direction of the ring. One of the bores, 21, which is slightly below the corner between the hot-top and the mould wall 23, is used to supply gas to the ring, while the upper bore 22 is used to supply oil to the ring. The oil and gas are supplied to the ring under a certain pressure, and since, with the exception of the sides 23,24 facing the mould cavity 4 where the metal is present during casting, the sides of the ring are provided with a sealing agent, the gas and oil will penetrate the ring from the bores 21,22 and come into the mould cavity 4. In figures 1 and 2, the sides provided with the sealing agent are marked with somewhat thicker lines.

At its lower end the ring 20 is provided with a tongue 27 which corresponds to a groove 26 in the projection 15 of the sleeve 12. By means of a simple screw-clamping connection 28, the ring 10 is pressed against and securely fastened to the sleeve 12. The base frame 18 is made of square pipes 29, which supply water to the mould via a slot 30 between the sleeve leg 17 and a water slot profile 31. On the sleeve projection 15 a downwardly protruding tongue, 32 is provided which deflects the water jet and leads it downwards and inwardly towards the metal being cast.

The performance of the casting is as follows: the support 5 is stationed in its upper position sealing off the outlet of the mould. Oil and gas are supplied to the ring 20, simultaneously with the water supply valve being opened. Molten metal, for instance aluminium, is now poured into mould inlet 1.

As soon as the metal at the lower part of the mould begins to solidify, the support 5 may be lowered. A gas cavity is created along the periphery of the mould at the corner below the hot-top 10, and as the metal flows downwardly, a gas and oil film or layer is provided between the metal and the mould wall.

As the walls of the mold cavity define a rectangular opening, an ingot with rectangular cross section is produced. The casting cycle is stopped when the support has reached its lowermost position.

Casting of the type described above is known as semi-continuous casting. The casting does not only take place in one mould at a time, but in several moulds simultaniously as the moulds are interconnected in groups.

Figure 2 shows a cross section of the mould wall in an area where the oil is supplied to the permeable ring 20. As will be apparent from Figure 2, the oil is supplied through bores 33,34 in the sleeve 12 and further via a transverse bore 35 into the bore 22 in the ring 20.

Between the ring 20 and sleeve 12 a gasket 36 is provided which prevents the oil from entering into the space between the sleeve and the ring. A corresponding arrangement (not shown) is provided for the supply of gas to the other bore 21.

Figure 3 shows the ring 20 in a smaller scale, seen from above. The ring is composed of several elements being glued to one another at their ends 40. In this example, the ring consists of six long side elements 37, two short end elements 39 and four corner elements 38. The oil and gas supply 41 is connected to the ring. As can be seen, the oil and gas is supplied to each of the long sides and each of the short ends repectively.

Though Figure 3 shows a permeable ring made of several elements, it is obviously possible, within the frame of the invention, to make the ring from one single piece of permeable material. Further, it is obvious that the ring according to the invention can have other cross sections that those shown in Figures 1 and 2, and can be used for casting other ingot shapes than the one previously mentioned.

Figures 4 and 5 show the cross section of a circular ring assembled by means of gluing and which is used in casting apparatus for casting ingots with circular shape. The ring is made of ring elements 42,43,44 being provided with grooves 45 which after assembly form rectangular or circular holes (bores) 46 in the ring.

Figure 6 shows another example of a permeable ring made of two ring elements, where an upper ring element 47 partly overlaps a lower ring element 48. The two elements 47,48 are attached to one another by means of gluing.

A slit 49 is provided between the two ring elements in their peripheral direction for the supply of oil to the ring via two diametrically arranged bores 50 (only one bore is shown in the figure). The overlapping provides a more even oil distribution through the ring.

Gas may be supplied to the ring element 48 through a groove 50 stretching along the circumference of the ring.

Claims

1. Continuous or semi-continuous casting apparatus for casting metallic materials, particularly rectangular ingots of aluminium, comprising a mould which has an inlet for molten metal and a mould cavity with an outlet water supply means being provided to cool the metal, emerging through the outlet, the mould cavity, at a distance from its inlet, being provided with a permeable ring for the supply of oil and/or gas,

to form a layer of oil and/or gas between the metal and mould wall whereby the metal is prevented from coming into contact with the mould wall before it solidifies, characterized in that the surface of the ring 20, with the exception of the side 23,24 facing the mould cavity 4, is provided with a sealing agent which prevents the oil and/or gas from escaping through the surface, and in that the ring 20 in its peripheral direction is provided with longitudinal bores or holes 21,22 for supplying oil and/or gas to said ring 20 via bores 33,34,35 which extend from the outside of the mould through the mould wall 12 and further into the ring 20.

2. Casting apparatus as claimed in claim 1, wherein the permeable ring 20 is made of graphite.

3. Casting apparatus according to claim 1 or 2, where the mould, slightly above the mould cavity is provided with an inwardly protruding, heat isolating material, hot-top, characterized in that the permeable ring 20 is disposed in the mould wall at or in the corner between the hot-top 10 and the mould cavity wall 12 and in that the ring 20 is provided with two parallel bores in its circumferential direction, one upper bore 22 for the supply of oil and a lower bore 21 for the supply of gas to the ring.

4. Casting apparatus according to any preceding claim, characterized in that the cross section of the ring 20 is rectangular and in that the upper part of the ring stretches up to or slightly beyond the corner between the hot-top 10 and the cavity wall 4.

5. Casting apparatus according to any preceding claim, characterized in that the ring 20 is provided with an outwardly protruding step 25 at its upper end, whereby the lower side 24 of the step 25 is at the same level or slightly above the plane forming the lower side 11 of the hot-top 10.

6. Casting apparatus according to any preceding claim, characterized in that the bore 21 for the supply of gas is provided in the area slightly below the corner between the step 25 and the lower part of the ring, whereas the bore 22 for the supply of oil is provided above said corner.

7. Casting apparatus according to any of claims 1-6, characterized in that the ring 20 is kept in position by means of a simple clamping device 28.

8. Casting apparatus according to any of claims 1-7, characterized in that the ring 20 is made of elements 37,38,39,40 which are fixedly attached to one another at their transverse ends by means of gluing.

9. Casting apparatus according to any of claims 1-7 wherein the ring has a circular shape, characterized in that the ring 20 is made of ring elements 42,43,44 provided with grooves 45 which, after the ring 20 is assembled, for instance by means of gluing, forms holes or bores 46 in the ring.

Fig.1

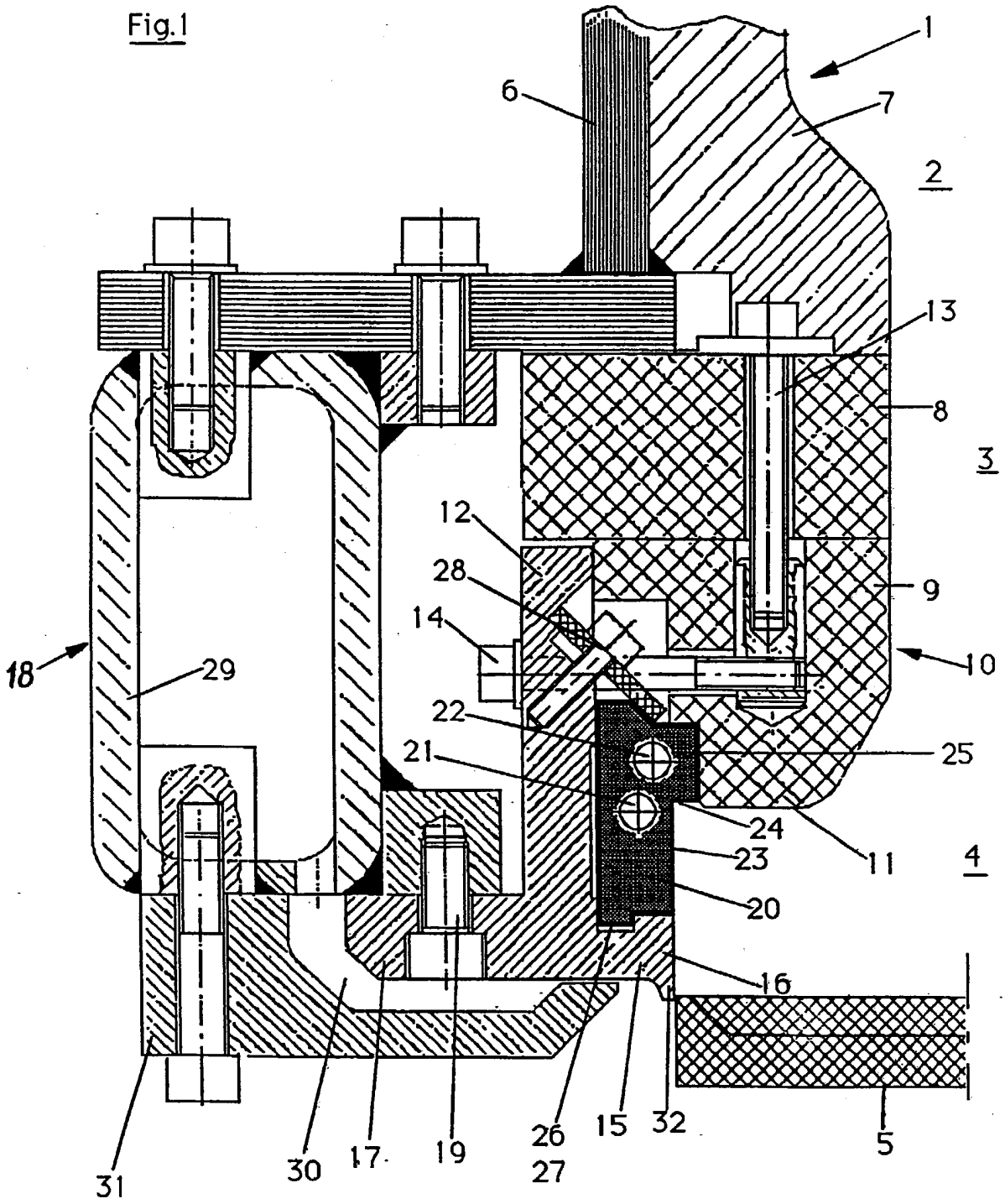
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Fig. 2

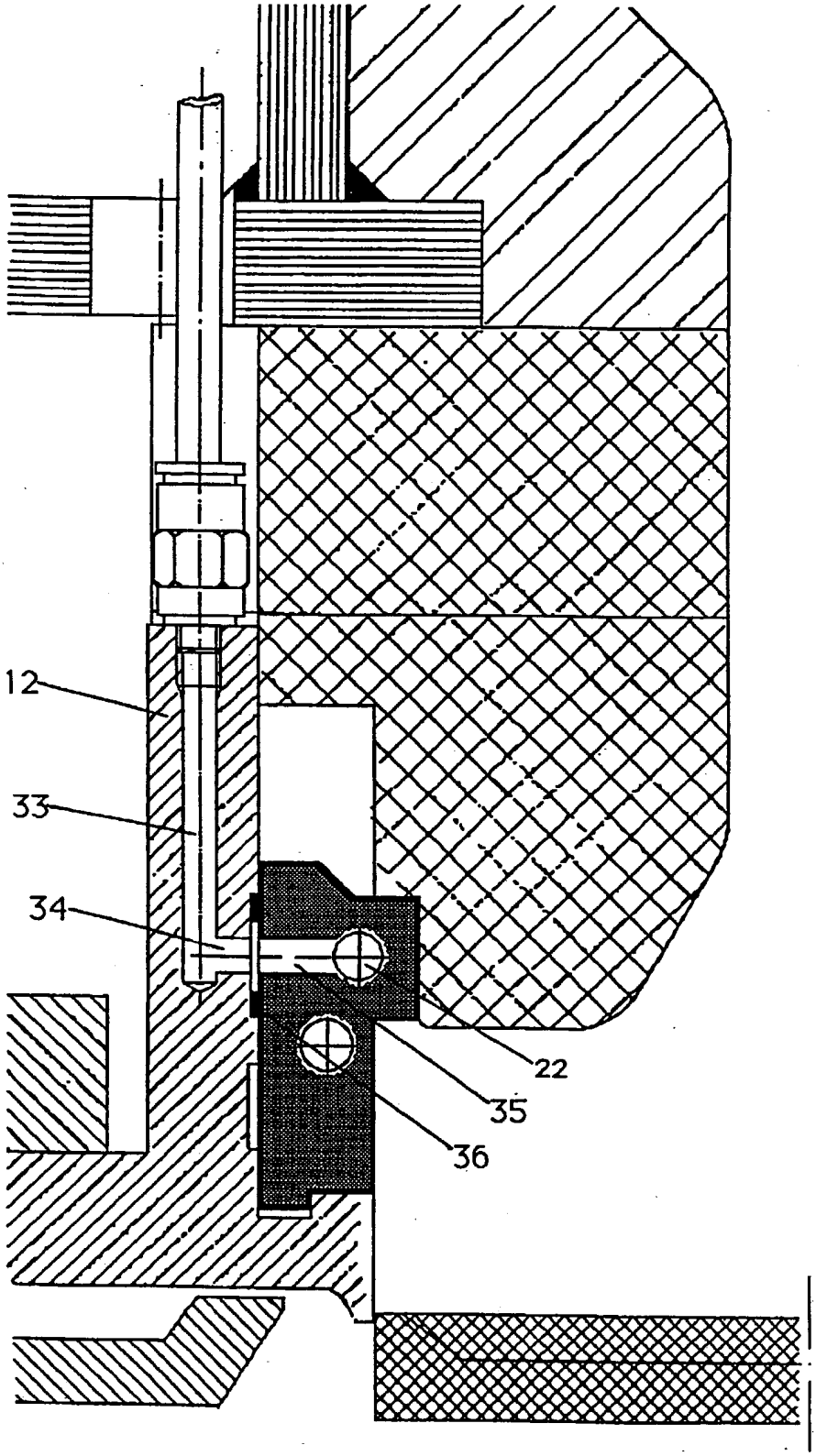

Fig. 3

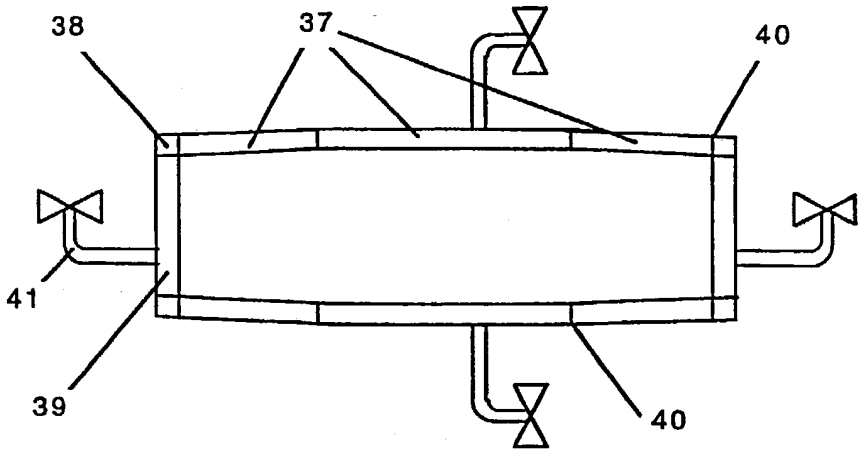

Fig. 4

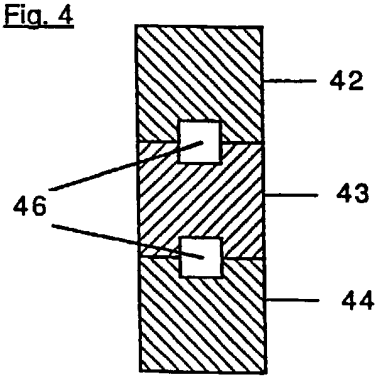

Fig. 5

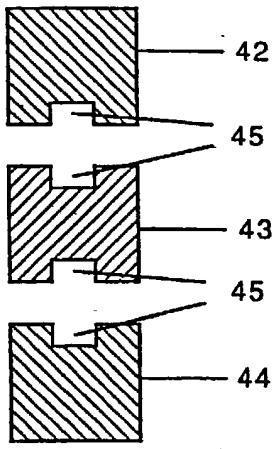

Fig.6